# Fictional storybooks as a scientific and epistemological question-building tool for primary school

Catherine Bruguiere, Eric Triquet, Mohamed Soudani, Jean-Loup Heraud

# FICTIONAL STORYBOOK AS A SCIENTIFIC AND EPISTEMOLOGICAL QUESTION-BUILDING TOOL FOR PRIMARY SCHOOL

*Catherine Bruguière*[1], *Eric Triquet*[2], *Mohamed Soudani*[3] *and Jean-loup Héraud*[4]
[1234] S2HEP, EA 4148, Université de Lyon, Lyon F-69000, Université Lyon 1, Villeurbanne, F-69622, France

*Abstract:* This work is focused on a specific type of children's storybook literature, specifically realistic works of fiction, in which the plot reflects laws of nature. This paper explores two storybooks : *Fish is fish* by L. Lionni and *The Promise* by J. Willis et T. Ross. These two stories express implicitly notions of biological development. An analysis of the fiction and the non-ficiton, which exists in these storybooks, allows us to explore how the story's intrigue as well as certain problematic wording can constitute a starting point for scientific as well as epistemological research on the development of living things.

*Keywords*: Fictional storybook, possible world, problematic process, biological phenomena

## INTRODUCTION

The direction taken by the French curricula for Elementary Schools in recent years (2008), which now prioritize 'speaking, reading and writing' across the disciplines, has opened up new opportunities for science-teaching at this level. While this orientation has led to an increased number of readings of informational books, it is less common to use fictional storybooks.
In a previous publication (Bruguière and all, 2007) we showed the potential effects on pupils learning of storybooks, leading to an interrogation of a scientific and epistemological nature. Here, we will focus this reflection on the functioning to the relationship between real and possible worlds in two unusual fictional storybooks: *fish is fish*, (Lionni, 1970 translated in French 1981) and *the tadpole promise (*Willis and Ross, translated in French 2005) in which the plot is based on the different physical changes which each character experiences. The aim of our research is to identify the role of fictional storybooks in scientific and epistemological question-building. The view of science taken in this study is one that emphasizes an investigative nature and the desire to broadly view the contexts for investigation, as noted by the Yager's definition, cited by Butzow (1998) : "*Anything that promote explanations, encourages the creation of explanations, or calls for verification and validation is scien*ce". Furthermore we see with Canguilhem, (1965) that « *Knowing is not so much about knocking up against reality as validating a possibility by making it necessary. In this case, the origins of a possibility are as important as the demonstration of a necessity*. »

## BACKGROUND

In reference to possible worlds semantics of Hintikka (1989) considers that there is no break between the possible and real, we are in a more epistemological proximity between science and the story in a report of opposition. For Hintikka, the fiction of possible worlds built on the basis of a real world or a possible world which may or may not occur and towards which we can distinguish between two epistemic attitudes: one on the mode of belief or another mode of knowledge. If knowledge is true by definition relates only to the real world, the belief can be

true or false but Hintikka false belief is not at all a negative because it opens the possibility of coming true in a world alternative. We can appreciate the scope of the heuristic fiction by creating all possible worlds helps to get students of the register of belief in the register of knowledge, and develop in them a critical epistemic attitude, which is the issue of the science education. The posture of Hintikka cannot be described as Bachelard in the sense that there is no rupture between common knowledge and rational knowledge. In the same way Bruner (2002) thinks, "When we invent possible worlds of fiction, we can never really leave the world which we are familiar." Bruner (2002) postulates an effect of fiction on the construction of a rational relation to reality. This epistemological position opposed to that of Popper (1985) for whom the stories are fiction out of science, do not belong to the same world.

Children ‘s literature may be playing an increased role in science classrooms. Nevertheless, most studies have found many inaccuracies in science trade book and have highlighted the need for teachers to carefully select appropriate trade books for classroom use (Rice 2002). To assist in this process, several checklists of books included the identification of inaccuracies have been created (Rice, 2002). For example, Schussler (2008) critically analyses numerous science trade books and asses the information they contain about plant reproduction. In theses studies the sample of children’s books include fictional storybooks, narrative and non-narrative informational texts. However, the fictional storybooks aren’t in keeping with the same plane in relation to scientific validity. In the fictional story, we cannot consider elements like false but like plausible or possible. The interest of our study lies in focusing on the fictional storybooks for there has not been much research in this field. In this way, Butzow (1998) estimate that fictional storybooks can be used to keep alive this sense of wonder and can become a vehicle through which science is learned. As Bruner (1996) or Ogborn and Millar (1998) said about a similarity between narrative and scientific explanation, we make the hypothesis that the plot structuring for the story is also structuring to generate scientific and epistemological questions. In the context of didactic studies (Butzow and all, 1998) which takes the articulation between reading and writing as a necessary condition for the process of conceptualisation, we hypothesize that the use of fiction will improve the comprehension of the real for primary-school children. Thus, the illustrations and texts cannot be interpreted without interrogating the real objects to which they refer but from which they are differentiated in perceptive and conceptual terms. We will see how this narration is not a mere fictional story having no relationship to the realities of animal life, but instead uses animals so to impart knowledge to the reader about how animals truly live, act and behave in nature. This provokes the reader to reexamine his previous understanding of nature, while at the same time encourages him to develop his knowledge even further.

## RESEARCH QUESTION AND HYPOTHESIS

In this background, we think that fictional storybooks present a learning opportunity that cannot be obtained through the use of traditional textbooks. Fictional storybooks create many possible worlds that are not completely unrealistic and have links to the real world.

Our global aim is to identify the role of fictional storybooks in scientific and epistemological question-building. More precisely we propose to study in our communication one of the narrative functions , the role of fictional narrative in the problematic process.

The problematic process will be explored according to two levels : a global level, around the structure of the plot and a more local level, around specific wording. Indeed the story books presents a « golden sentence » at the heart of the intrigue (Tompkins, 2003) which represents the message of the storybook. The repetition of this wording throughout the course of the story takes on multiple meanings in a storybook that can be problematic.

In this way we consider two hypothesis in the problematic process :

- The plot structuring for the story is also structuring to generate problematic questions.

In others words, the story presents a fictional problem, which corresponds to a scientific problem.

- The diffents meanings taken by a wording (title or term) throughout the story generate problematic questions

# METHOD

Our case study compares two fictional storybooks: « Fish is Fish » (Lionni, 1970 translated to French in 1981) and « The Tadpole Promise » (Willis and Ross, 2003 translated to French in 2005). These books were selected for the three following didactic reasons:

- They have yet been chosen by science education researchers as examples that promote an integrated approach (Butsow, 1998, Avel and Lanoizelé, 2008);
- They offer a story related to science, but this story is not expressed in scientific terminology. The narrative glues together the fiction and the real world and presents them at a level of accessibility that is appropriate for the child;
- Their plot is based on biological phenomena, in other words, on the different physical changes which each character experiences. More, the plot is based on the same disruptive event, the same incident : the occurrence of hind footed to the tadpole.

For this study, we will examine on one hand the development of the plot, from its beginning to its outcome. Using the Larivaille Method (1974) we will look at the five following steps : Beginning state- Intrigue- Development – Resolution- Final state. According to this method, the plot is defined as a transformation from a balanced state (Beginning state) to another balanced state (Final state). The goal of the analysis is identified as how the biological phenomena connect to the different steps of the plot in the two stories.
On the other hand, we will examine the differents meanings taken on by problematic sentences throughout the story. How do the meanings evolve ? What new scientific questions will these new meanings provoke ?

# RESULTS

## Results 1 : The plot generate analytical and problem-solving tools

We will see how to fully understand the plot one must fully understand the scientific phenomena because the development of the plot in the two stories is overlapped with the biological phenomena (tableau 1).
The plot revolves around the relationship that unites two characters. In The tadpole's promise, the relationship is romantic, while in Fish is Fish, the relationship is between friends. In the two stories, the plot is based on the same disruptive event : the appearance of hindlegs on the tadpole which has the potential to threaten the relationship between the two characters. Is it possible for the relationship (love or friendship) between the two characters to continue despite the morphological and anatomical changes which effect the tadpole ?

| **The plot** | ***Fish is fish*** | ***Tadpole's promise*** |
|---|---|---|

| | | | |
|---|---|---|---|
| **Beginning state** | In two different environments, at the frontier between the pond and the bank of the pond (in *Tadpole's promise*: *Where the willow meets the water a tadpole met a caterpillar.)*<br>The opening places the development of the characters at the same time: when they are larva. | | |
| **Intrigue development** | **First complication** | **Fact** : The appearence of hindlegs on the tadpole distinguishes the tadpole from the fish, making them different.<br><br>**Scientific problem**: Is the appearence of hindlegs a clue that the tadpole does not belong to the same species of fish as the minnow ?<br>What can allow us to say that the tadpole is a fish or a frog? | **Fact**: The appearance of the two hindlegs on the tadpole changes the tadpole.<br><br>**Scientific problem**: Does the appearance of hindlegs change the identity of the tadpole?<br>Do these morphological changes exist for every animal?<br><br>→ The first complication happens three times: he grew legs, then he grew arms and finally he has no tail. |
| | **Second complication** | When the tadpole develops into an adult frog and jumps out of the water onto the bank. The frog discovers the terrestrial world.<br><br>When the frog comes back, he describes to the fish *the extraordinary things that he has seen*: a bird, a cow and so on. The fish imagines the different animals.<br><br>**Scientific problem**: how can we imagine animals that we have never seen before? Animals | When the caterpillar develops into a butterfly but can't recognise the tadpole who has developed into a frog.<br><br>**Scientific problem** : does the same animal persist between the larva and the adult form? |

| | | | |
|---|---|---|---|
| | | that don't live in our environment? | |
| **Resolution** | | When the '*fish jumped clear out of the water onto the bank, ... he lay gasping for air, unable to breathe or to move'. 'Luckily, .. the frog.. pushed him back into the pond'.*<br><br>**Scientific problem**: Why can the frog breathe on the bank and not the fish, while the tadpole can breathe in the pond like the fish? | In *Tadpole's promise*, the resolution of the story happens when *the frog leapt up and swallowed her.*<br><br>**Scientific problem** : Why can't the tadpole eat the caterpillar while the frog can eat the butterfly? |
| **Final state** | | When the frog and the minnow remain friends. Each one stays in his environment.<br><br>**Scientific problem** : what biological relationship exists between an animal and its environment? | The frog is alone, the butterfly has disappeared.<br>*The frog waits thinking fondly of his beautiful rainbow wondering where she went.*<br><br>**Scientific problem** : What becomes of the butterfly when she has been eaten by the frog? Is she still 'butterfly matter' or has she become 'frog mater'? |

| | | | |
|---|---|---|---|
| | | | |

**Tableau 1 : The events of the plot with the biological phenomena overlapped**

Thus, in the two stories, biological phenomena are overlapped with the events of the plot. They are connected to each step of the plot and the plot is resolved according to real world restrictions.

## Results 2 : certain wording generates problematic questions

Here the analysis consists of capturing the problematic dimensions of the storybook, which can often be found in either the title or the content of the story. In *Fish is Fish*, the problematic dimension is highlighted in the title. It is interesting to note that the French translation, *Un poisson est un poisson*, differs from the original English in the sense that the indefinite article, *un* , is used. This makes it clear that any fish, such as cod, trout, brill, bass, etc. can be part of the same specises. In *Tadpole's promise* the sentence *Promise you'll never change,* is repeated throughout the story and carries with it this problematic character. The promise is problematic because it is something that can never be realized. A tadpole will inevitably change into a frog.

Here we propose to focus on the different ways to read, question and understand the problematic wording : In *Fish is fish*, the changes in meaning occur while reading the storybook happens at two precise moments in the story.

### 1/ During the first complication

*« One morning the tadpole discovered that during the night he has grown two little legs. "Look" he said triumphantly. "Look, I am a frog !" "Nonsense", said the minnow. "How could yo be a frog if only last night you were a little fish like me ! They argued and argued until finally the tadpole said, "Frogs are frogs and fish are fish and that's that !"*

We can consider that the incomprehension between the two characters comes from different meanings seen in *Fish is Fish*. The two characters express implicitly ou explicitly two opposite meanings

For the fish: *Fish is fish* means implicitly that a fish stays a fish. The fish is considered as a single fish. Consequently the tadpole who is his inseparable friend and thus lookes like a fish will stay a fish. In fact, both characters are wearing the same green and red colors. Their expressions are similar, the graphics of the eye and mouth opening, give them a little « air de famille ».

For the tadpole : Fish is fish means explictly that a single fish is one member of the fish species.

If the fish gives the same meaning to the two fish terms, the tadpole gives a different meaning to each fish term, an expression that he applies to frogs and that he could apply to every specises.

The conflict of meaning permet de relier la question de l'identité à celle du développement. Plus encoe, The link between 'tadpole' and 'frog' (qu'exprime en parlant de grenouille et non plus de têtard) introduces the idea of the permanence of the identity of the animal during its development

Fish is fish, here is set against the truth spoken by the tadpole, who comprehends Fish is fish only from the point of view of frogs as a group
The use of the plural of 'grenouile' / 'frog' highlights the fact that the French 'un' (absence of pronoun in english) of the title refers to a plural.
The link between 'tadpole' and 'frog' introduces the idea of the permanence of the identity of the animal during its development

**2/ During the resolution**

The crucial experience of the fish allows the fish to test his beliefs about his identity. He could not breath on land like the frog, therefore he is not a frog but a fish. In this situation, the breathing becomes as a relevant criteria to define identity. The appearance of the hindlegs did not act as a criteria of distinction for the fish.
This time the fish gives explicitly with "you know, you were right, fish is fish" the same meaning as the frog does. We go from the truth about a single character (tadpole/frog) to a state of shared knowledge after an experience which almost cost the fish his life. *Fish is fish* is no longer only the truth about one character, but words proven by experience
This work opens up a reflection of the criteria of animal classification

## CONCLUSION AND IMPLICATIONS

We propose to consider a new kind of picture book define as « realistic fiction », meaning that the narrative may convey certain elements of scientific knowledge
More precisely, these specific fictional storybook can be characterized as «realistic fiction» if :
- the story presents a fictional problem, which corresponds to a scientific problem,
- the fictional narrative is held together by scientific phenomena. The plots question the real world.
- there is a problematic wording

Thus, to fully understand the «realistic fiction», pupils must fully understand the scientific phenomena. In this way, such story book question beliefs ans interrogate our representations of the world allows one to explore the possible explanation by confronting fictional imagined worlds with the real world, allows one to connect the bordaries of the real world through the use of the imagined possible worlds which are created by fiction.
As Butzow (1998) said, in these books, we think that the scientific content is not merely a chance to introduce a reading, it becomes a « character » in the story, without which the book would cease to exist. The «realistic fiction» is not considered a pretext for introducing scientific content. Rather, it creates the context for the scientific problem. The both characteristics: multimodal aspects of texts and the association to the strong science theme related to the plot, open new perspectives for literacy learning. Such picture books represent an under- explored resource for teaching science at the primary school level. Our research perspective is to explore how these storybooks can be effectively used in the science classroom.

## REFERENCES

Avel, P. & Lanoizelé A-M,. (2008). Apprendre pour comprendrre. Une autre relation entre literrature et science. *Cahiers pédagogiques*, 462.
Bruguiere C., Heraud J-L., Errera J-P. et Rembotte X. (2007). Mondes possibles ert compréhension du réel. La lecture d'un album en cycle 2 comme source de questionnement scientifique. *Aster*, 44. pp.. 42-69
Bruguière C. & Héraud J-L (2009). *Questionner l'implicite dans les méthodes de recherché en didactique*. Les implicates lies à l'exportation d'une cadre théorique : une navigation inductive en didactique de la biologie. Cora Cohen-Azria et Nathalie Sayac Editeurs. Presses universitaires du Septentrion. p.118-133.
Butzow, C M. & J.W. Butzow (1998). *More science trough childrens'literature. An integrated approach*. Teacher ideas press, Englewood, USA. 245 p.
Bruner, J. (2002). *Pourquoi nous racontons-nous des histoires* ? Paris : Retz, 112 p.
Hassett. D.D. & Curwood J.S. (2009). Therorie and Practices of multimodal education : the instructional dynamics of picture books and primary classrooms. *The Reading Teacher*, 63(4).
Hintikka (1989). *L'intentionnalité et les mondes possibles*. Lille : Presses universitaires de Lille.
Larivaille, P. (1974). L'analyse morphologique du récit. *Poétique,* 19, 368-388.
Orgborn, J. & Millar, R. (1998). *Beyond science: Science education for the future*. London: King's College.
Popper (1985). *Conjectures et refutations*. Paris : Payot
Rice. D.C. (2002). Using trade books in teaching elementary science : Facts and fallacies. *The Reading Teacher*, 55 (6), pp.18-22
Schussler, E. (2008). From flowers to fruit : how children's books represent plant reproduction. *International Journal of Science Education*. Vol.30, N° 12, pp. 1677-1696.
Tompkins , G. (2003). *Literacy for the 21st century*. Upper Saddle River, NJ : Prentice Hall